ULTRASONIC EXAMINATION PROCEDURES

FOR CLOSURE HEAD AND RECIRCULATION PUMP

STUDS AND NUTS

LONG ISLAND LIGHTING COMPANY

SHOREHAM NUCLEAR POWER STATION

UNIT 1

Prep'd by _____ 10-18-77
Date

NES _____ 10-18-77
Project Mgr. Date

NES _____ 11-1-77
Mgr. ISI Level III Date

NES _____ 10-19-77
ISI Program Mgr. Level III Date

NES _____ 11-2-77
QA Mgr. Date

LILCO _____ 7/19/78
Date

_____
Date

Rev. No.	Date
0	10/19/77
1	5/20/83

RECORD OF REVISIONS

Rev. No.	Date	Description	Reason	Prep'd by	App'd by	
					NES	LILCO
1	5/83	Para. 8.2(.1) and (.5) clarification of technique	Exam requirements/customer comments.	B	B	6-13-83
1	5/83	Para. 5.3.1 change to certify that couplant not exceed 50 PPM halogens and 200 PPM sulfur. SEE CRA 3327	Exam requirements/customer comments.			6-13-83

ULTRASONIC EXAMINATION PROCEDURES FOR CLOSURE HEAD AND RECIRCULATION PUMP STUDS AND NUTS

1.0 SCOPE

1.1 Area of Examination

This document covers the ultrasonic examination procedures for the Closure Head and Recirculation Pump Studs and Nuts.

1.2 Type of Examination

1.2.1 Volumetric examination shall be performed using ultrasonic pulse echo 0° straight beam techniques applied to one end surface of the studs and to one end surface of the nuts and nominal 45° angle beam shear wave applied to the OD of the nuts.

1.2.2 The examination shall be performed manually using contact search units (transducers).

1.3 Time of Examination

These procedures shall govern the preservice examination and re-examination of repaired areas of the Closure Head and Recirculation Pump studs and nuts as required by the ASME Boiler and Pressure Vessel Code, Section XI.

1.4 Part Configuration

1.4.1 Typical Closure Head stud and nut configurations and nominal dimensions are shown in Figures 1 and 2.

1.4.2 The Recirculation Pump stud and nut configuration and nominal dimensions are shown in Figures 3 and 4.

1.5 Materials

The Closure Head studs and nuts are constructed of low carbon steel (SA-540 GrB24). The Recirculation Pump Stud (SA-540 GrB23) and nut (SA-194 CL7) are also carbon steel.

2.0 REFERENCES

2.1 Reference Documents

The following documents form a part of this examination procedure:

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1971 Edition and the Summer of 1972 Addenda.

(2) ASME Boiler and Pressure Vessel Code, Section III, 1971 Edition and the Summer of 1972 Addenda.

(3) ASNT Recommended Practice, SNT-TC-1A, Supplement C, Third Edition (1971).

(4) ConAm Procedure for Certifying Inspection Personnel, CUTP-1, Rev. 4, September, 1975.

(5) ConAm Procedure for Ultrasonic Instrument Linearity Verification, 25-PS-002, Rev. 2, November, 1975.

2.2 Applicable Drawings

The following drawings are part of this procedure:

(1) CE Assembly Dwg. E-234-254

(2) Byron-Jackson Dwg. 1E-3429-2

2.3 Operational Manuals

The equipment operational manuals for the particular ultrasonic instruments used form a part of this procedure.

3.0 PROCEDURE CERTIFICATION

The examination procedures described in this document comply with Section XI of the ASME Boiler and Pressure Vessel Code, 1971 Edition including Summer 1972 Addenda, except where examination coverage is limited by part geometry or access.

4.0 PERSONNEL CERTIFICATION

4.1 Personnel Certification Requirements

4.1.1 Each person performing ultrasonic examination governed by this procedure shall be certified in accordance with the References 2.1 (1), 2.1 (3) and 2.1 (4).

4.1.2 An examination crew shall consist of one or two members as needed. At least one member of each crew shall have a minimum qualification of Level II in accordance with the above referenced documents. The remaining member shall have a minimum qualification of Level I.

4.2 Personnel Records

4.2.1 Records of personnel qualification shall be maintained by Examination Contractor.

4.2.2 A copy of the examiner's certification summary and a current eye test as required by SNT-TC-1A shall be filed with each permanent examination record, with a copy submitted to the plant owner or his agent, prior to performing examination per this procedure.

5.0 EXAMINATION REQUIREMENTS

5.1 Examination Frequency

5.1.1 The nominal examination frequency shall be 2.25 MHz for all straight beam examinations.

5.1.2 During preservice examination, other pulse frequencies shall be used only if such variables as material attenuation, grain structure, etc., necessitate their use to achieve penetration or resolution. This information shall be recorded on the data sheets (Figure 10).

5.2 Examination Angles and Coverage

5.2.1 The intent of this procedure is to provide maximum examination coverage to ensure part integrity. Each part shall be scanned with minimum 25% overlap of the transducer width (diameter) for each scan pass.

5.2.2 The rate of search unit movement shall not exceed six (6) inches per second.

5.2.3 Each stud shall be ultrasonically examined where part geometry and access permit, using 0° straight beam techniques applied to the top end of the stud.

5.2.4 Each nut shall be ultrasonically examined where part geometry and access permit, using 0° straight beam techniques applied to the upper surface of the nut. Each nut shall also be examined using nominal 45° angle beam techniques applied to the OD of the nut in two directions circumferentially.

5.2.5 Other angles may be used if required for aid in evaluation of reflectors or to accommodate geometric restrictions and limited access. All information shall be recorded on the data sheets.

5.2.6 Where examination surface, geometry or other conditions (contour, access, etc.) do not permit a meaningful ultrasonic examination to be performed, the examiner shall record the area of non-examination and the particular interfering condition in the space provided on the Calibration Data Sheet. In addition, he shall make a sketch of the part conditions on the reverse side of the calibration data sheet (Figure 10).

5.2.7 All examination areas shall be entered in the space provided on the Calibration Data Sheet. If there are no recordable indications, it shall be so recorded.

5.2.8 Coverage for the parts specified in Table 1 is shown in Figures 1, 2, 3 and 4.

5.3 Liquid Couplant

5.3.1 The ultrasonic couplant shall be suitable for use on nuclear plant material and certified not to exceed 50 PPM halogens and 200PPM sulfur.

5.3.2 The couplant shall be supplied in clean containers of sufficient quantity to perform the examination.

5.3.3 The couplant shall be applied manually with a brush or other suitable device.

5.3.4 Where required, the examiner shall be responsible for removing couplant from the examination surface at the conclusion of the examination.

5.4 Surface Preparation

All examination surfaces should be clean and free of dirt, etc., or any other condition which would interfere with the examination by impairing proper transmission of the sound beam, or by preventing free movement of the search unit along the examination surface.

5.5 Part Identification

Each part shall be located and identified per the appropriate map located in the Program Plan Book.

5.6 Datum Point

5.6.1 The examiner shall verify that there has been marked, a reference datum point on each weld from which all examination data and reported indications shall be referenced.

5.6.2 Datum points shall be marked by the use of low stress stamps or vibratooling and shall not be deeper than 1/32".

5.6.3 The datum point for each closure head stud shall be on a diametric line through the stud identification number at the outer edge of the stud nearest the number.

5.6.4 The datum point for each nut shall be on a diametric line through the nut identification number at the outer edge of the nut nearest the number.

5.6.5 Each datum point along with respective reference points and divisions shall be shown on each examination report.

6.0 EQUIPMENT REQUIREMENTS

6.1 Examination Contractor's Equipment

The following test equipment or its equivalent shall be provided by the Examination Contractor (as a minimum) for examination of the Closure Head and Pump studs and nuts:

(1) Pulse Echo Ultrasonic Instrument (in compliance with Ref. 2.1(1)).

(2) Search Units, 1/2" to 1-1/2" Dia, 2.25 MHz, 0°

(3) Search Units, 1/2" Dia, 45° angle beam, 2.25 MHz

(4) Couplant

(5) Camera

(6) Thermometer

6.2 Plant Owner's Equipment

The Plant Owner or his Agent shall provide the following service facilities and equipment as required:

(1) Scaffolding

(2) Water, Air and Electricity

(3) Temporary Lighting

(4) Crane or Lifting Devices

(5) Calibration Standard No. STUD-6 and STUD-3

(6) Calibration Standard No. NUT-6 and NUT-3

(7) Test Surface Preparation (cleaning and finishing)

(8) Drawings of Each Examination Area

(9) Post-Examination Cleanup of Test Area

7.0 CALIBRATION REQUIREMENTS

7.1 Calibration Data Sheets

Calibration Data Sheets shall be numbered 476-1, 476-2, 476-3, etc., at the time of calibration and shall be signed by the examiner(s) upon completion. Figure 10 is an example of the Calibration Data Sheet to be used with this procedure.

7.2 Calibration Standards

7.2.1 The calibration standards designated in Section 6.2.1 (5) and (6) shall be used for basic instrument calibration and for establishing reference sensitivity levels for examination of the specified parts (See Figures 5, 6, 7 and 8).

7.2.2 The identity of the calibration standard used for performing calibration shall be recorded on each Calibration Data Sheet.

7.2.3 Calibration procedures for the examination shall be performed using the surfaces of the referenced standard as shown in Figures 5, 6, 7 and 8.

7.2.4 The temperature of the calibration standard shall be within 25°F of the component temperature. Calibration standard and component temperatures shall be recorded on the Calibration Data Sheet.

7.3 Reference Sensitivity Level

7.3.1 The reference sensitivity level shall be the distance-amplitude curve initially obtained directly from the calibration standard and shall be the sensitivity level used for evaluating and recording all indications.

7.3.2 During actual part scanning, the reference sensitivity level shall be increased a minimum of 2X (6dB).

7.4 Times of Calibaration

7.4.1 Basic instrument calibration shall be performed using the appropriate calibration standard, search units and instrumentation immediately prior to the examination of the Closure Head and Pump studs and nuts.

7.4.2 Instrument vertical linearity checks shall be performed at the beginning of each day of examination in accordance with the procedure referenced in Section 2.1 (5), using an angle beam search unit applied to a suitable calibration standard.

7.4.3 Examination system calibration checks shall be performed at least at the beginning and at the completion of each four (4) hour period of examination and/or at the change of examination personnel, equipment, search units, coupler shoes, etc., and at the completion of the examination of each similar series of parts in accordance with Sections 8.1 and 8.2 of this procedure.

7.5 Calibration Response

7.5.1 Calibration response shall be checked at the primary reference sensitivity level.

7.5.2 Signal response obtained during calibration check shall be within plus or minus 20% of that established during basic system calibration.

7.5.3 If any point on the DAC curve has decreased by more than 20% of its amplitude, the examiner shall:

(1) Mark all data sheets void since previous calibration.

(2) Recalibrate examination system.

(3) Re-examine voided areas.

7.5.4 If any point on the DAC curve has increased by more than 20% of its amplitude, the examiner shall:

(1) Recalibrate examination system.

(2) Re-evaluate all indications recorded since the previous calibration at the corrected sensitivity level.

7.5.5 If any point on the DAC curve has moved horizontally more than 5% of the sweep line from its original settings, the examiner shall:

(1) Correct the sweep calibration and note it on the Calibration Data Sheet.

(2) Void any data sheets made since the previous calibration which have recorded indications and re-examine those areas.

8.0 EXAMINATION SYSTEM CALIBRATION

8.1 Nut Calibration

8.1.1 Straight Beam Calibration

Straight beam calibration for nuts shall be performed as follows and as shown in Figure 9.

(1) Adjust the instrument sweep controls so that the signal responses from the 1/4T, 1/2T and 3/4T holes occur at the second (2nd), fourth (4th) and sixth (6th) horizontal screen positions.

(2) Position search unit to obtain maximum response from the hole which gives the highest amplitude signal. Adjust sensitivity control to provide a signal amplitude of 80% of Full Screen Height (FSH) and mark location and amplitude on the CRT.

(3) Without changing sensitivity, position the search unit respectively on the remaining holes and mark signal amplitudes and locations on the CRT.

(4) Plot a DAC curve by connecting the locations (marked on the CRT) with a continuous line extended to cover the full examination range as shown in Figure 9.

(5) This is the primary reference sensitivity. Record all sensitivity control settings on the appropriate Calibration Data Sheet.

8.1.2 Angle Beam Calibration

(1) Adjust the instrument sweep controls so that the signal response from the ID notch occurs at the 8th horizontal screen position.

(2) Position search unit on the nut lateral surface to obtain maximum response from the ID notch. Adjust sensitivity control to provide a signal amplitude of 80% of FSH and mark location and amplitude on the CRT.

(3) This is the primary reference sensitivity. Record all sensitivity control settings on the appropriate Calibration Data Sheet.

8.2 Stud Calibration

Straight beam calibration for studs shall be performed as follows:

(1) Adjust the instrument sweep controls so that the signal response from the hole in the stud calibration block occurs at the 9th horizontal screen position and that the 3/4T hole from the corresponding nut calibration block occurs at about the 1st horizontal screen position. See Note.

(2) Position search unit to obtain maximum response from the corresponding nut 3/4T hole. Adjust sensitivity to provide a signal amplitude of 80% FSH and mark its location and amplitude on the CRT.

(3) Position search unit to obtain maximum response from the stud calibration hole and mark signal amplitude on the CRT.

(4) If the response from the stud calibration hole is not detectable at the setting obtained in (2) above, increase the sensitivity setting to provide a minimum of 20% signal from the stud calibration hole. Record the sensitivity setting difference on calibration data sheet for use in evaluation of indications.

(5) Plot a DAC line by connecting the locations (marked on the CRT) with a continuous line extended to cover the full examination range (horizontal screen positions 0 thru 9). See Note.

(6) This is the primary reference sensitivity. Record the sensitivity control setting on the Calibration Data Sheet.

(7) Record all data and instrument settings on the Calibration Data Sheet.

Note: For recirculation pump studs the 8th horizontal screen position shall be utilized for the stud calibration block hole.

8.3 Straight and Angle Beam Calibration Check

Straight and angle beam calibration check as required by Section 7.4.3 shall be performed as follows:

(1) Adjust the sensitivity control settings to those recorded for the calibrated reference sensitivity. See Section 8.1.1(2) and 8.1.2(2) for nuts or 8.2(2) for studs.

(2) Reposition search unit at each respective test hole or notch and observe signal response amplitudes and horizontal screen positions.

(3) See Section 7.5 for signal response requirements during calibration check.

9.0 EXAMINATION PROCEDURES

(1) Straight and angle beam examination of the closure head and pump studs and nuts shall be performed at a scanning sensitivity level 2X or 6 dB greater than the calibrated reference sensitivity level.

(2) A suitable scan pattern shall be used allowing a minimum of 25% overlap of the transducer width (diameter) for each scan pass.

(3) See Table 1 and Figures 1 through 4 for part designations and scan path distances.

(4) Continue scanning sequences until all parts have been examined. Equipment must not be removed from the area until all indications have been evaluated.

10.0 EVALUATION CRITERIA

10.1 Recording of Indications

10.1.1 All indications showing a signal amplitude response equal to or greater than 50% of the reference response shall be recorded on the appropriate data sheet at the time of part examination and prior to removing equipment from the examination area.

10.1.2 Each recorded indication shall be identified as to depth, length, signal amplitude and location relative to the part datum point.

10.1.3 Indications from all studs and nuts shall be reported in inches below the part datum point and in inches clockwise (CW) or counterclockwise (CCW) from the datum point, and in inches radially inward towards the center of the part when looking down upon the top of the part.

10.2 Evaluation of Indications

10.2.1 Evaluation of all indications shall be made at the reference sensitivity and in accordance with the requirements of the ASME Boiler and Pressure Vesse' Code, Section XI, IS-300. All evaluations shall be performed by a Level II or Level III.

10.2.2 Results of this evaluation shall be reported to the Plant Owner or his Agent in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, IS-600. Disposition of evaluation results shall be made in accordance with the Owner's Plant Procedures.

11.0 EXAMINATION RECORDS

11.1 Certification of Records

The examiner shall complete and sign all data sheets immediately upon the completion of each part examination. The data sheets may be reviewed by the authorized Code Inspector.

11.2 Filing of Records

The examiner shall be responsible for submitting to the Plant Owner or his Agent a completely documented set of examination records including certification of personnel qualifications with a current eye test report in accordance with SNT-TC-1A.

11.3 Procedure Corrections and Additions

11.3.1 All procedure corrections and/or additions required during the preservice examinations shall be made in accordance with requirements of NES QA Program Plan #NES 80A0448.

11.3.2 The examiner will contact the LILCO representative on site to initiate all such changes. All changes shall be documented in the record of revisions section of this procedure.

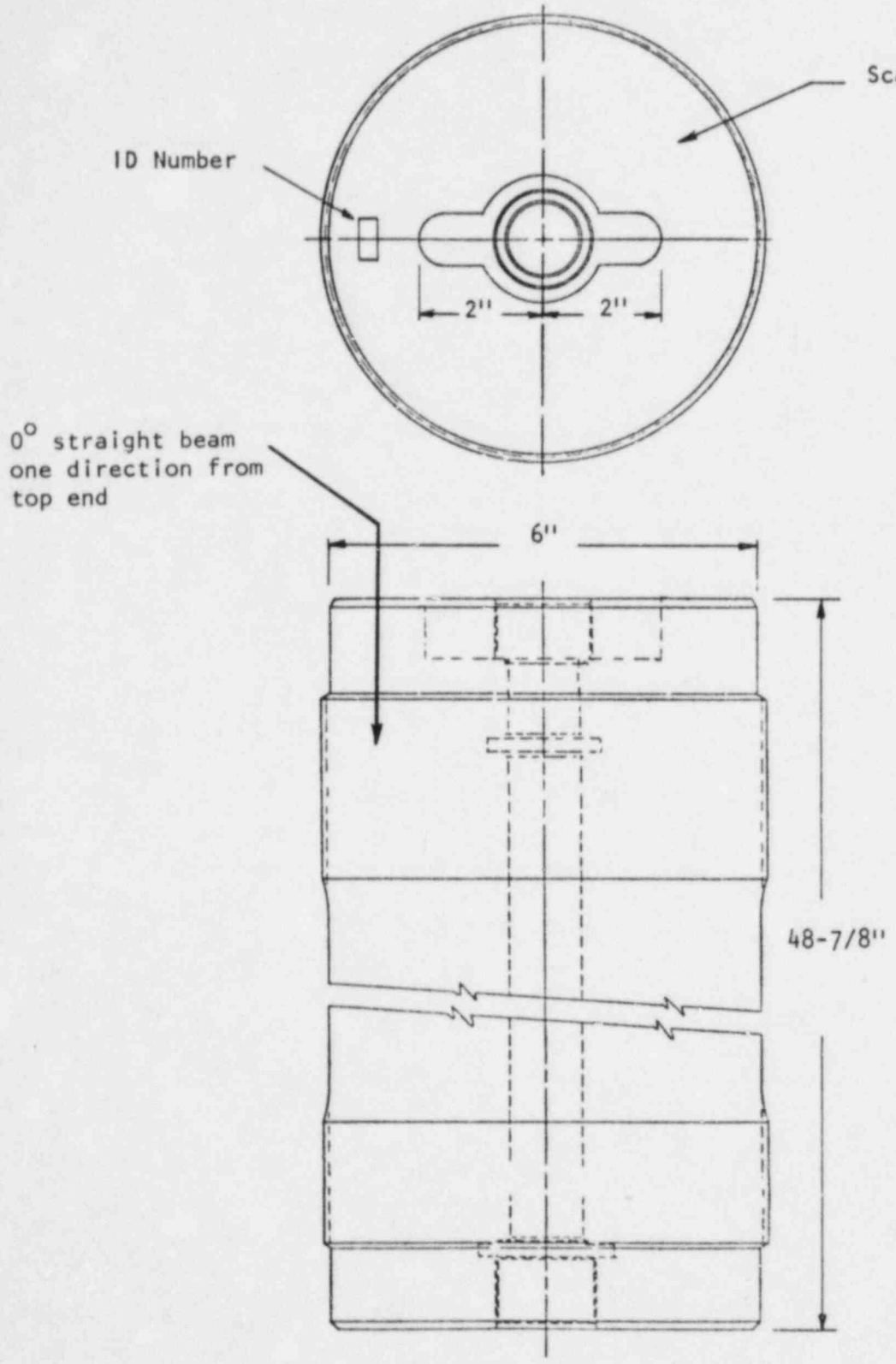


Figure 1. Ultrasonic Examination Procedures for Closure Head Studs

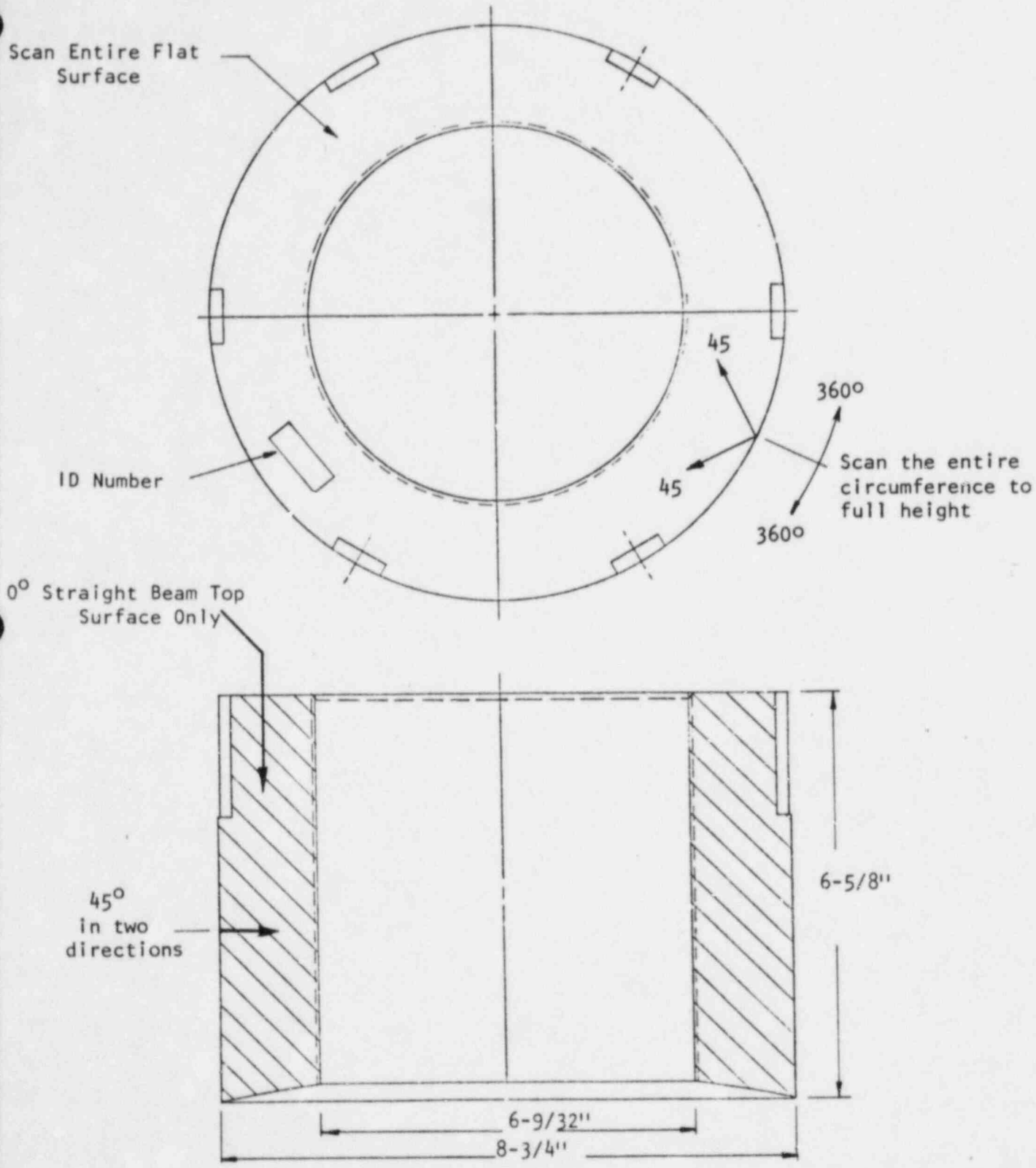


Figure 2. Ultrasonic Examination Procedure For Closure Nuts

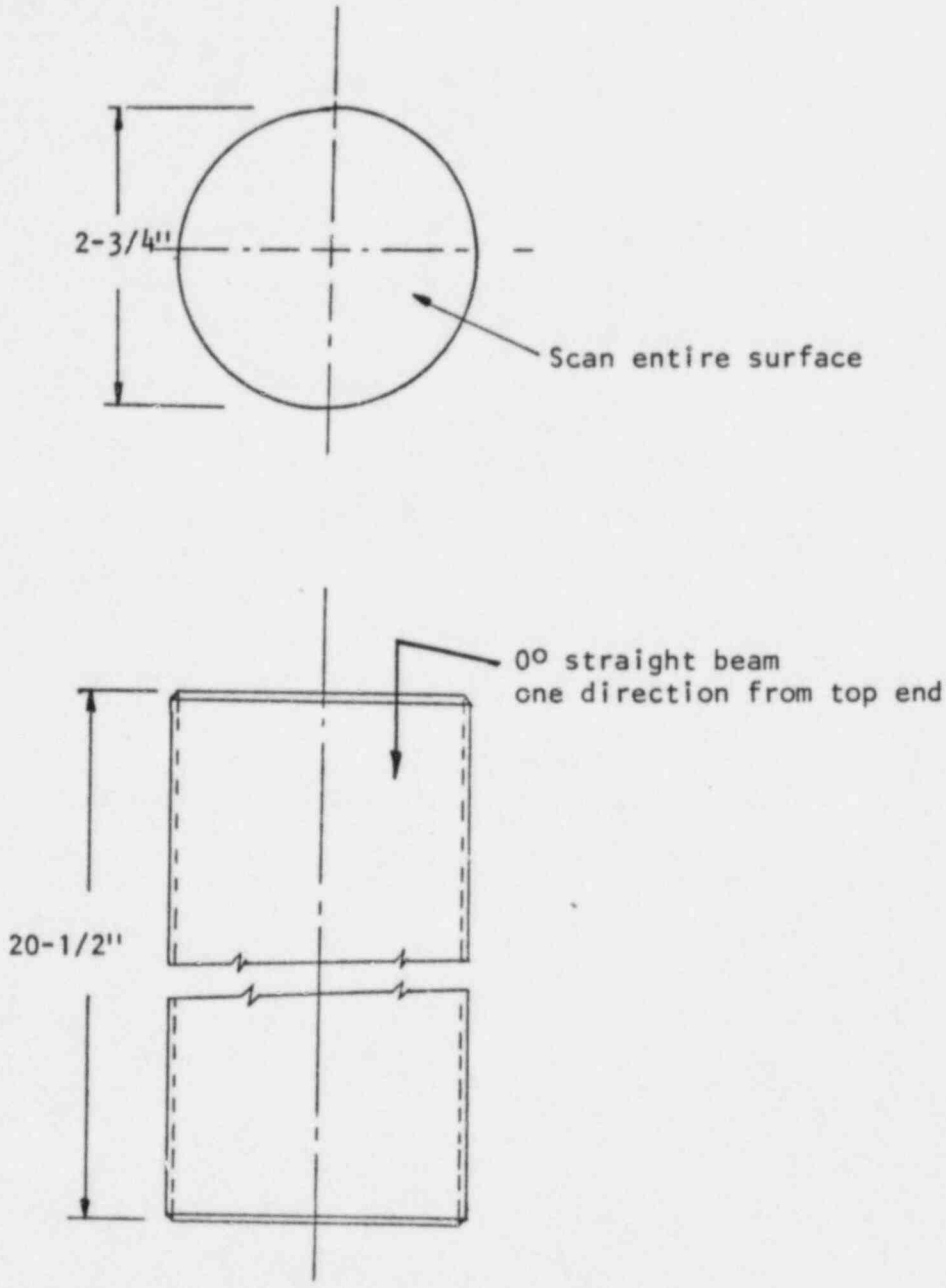


FIGURE 3 ULTRASONIC EXAMINATION PROCEDURE FOR RECIRCULATION PUMP STUD

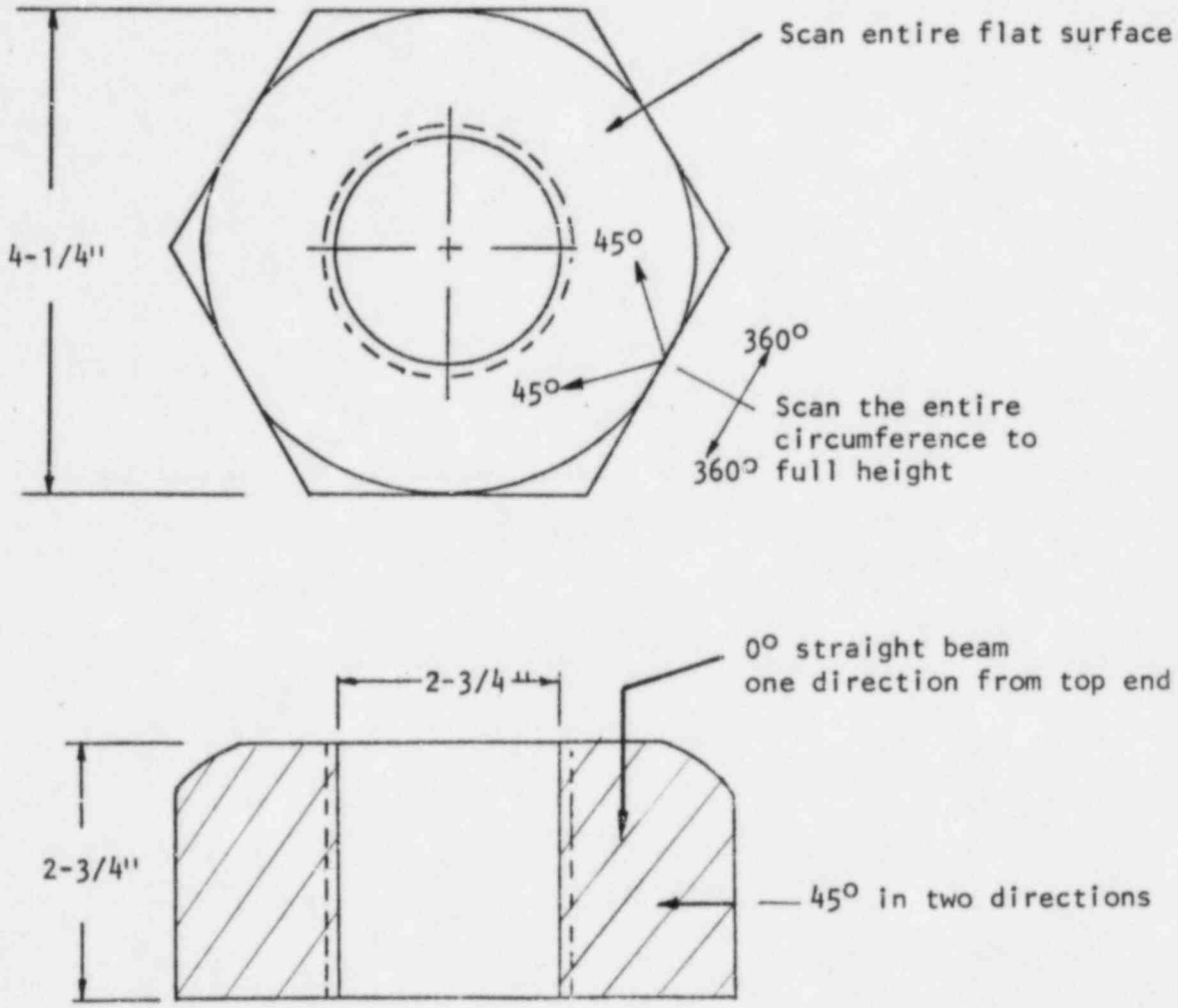


FIGURE 4 ULTRASONIC EXAMINATION PROCEDURE FOR RECIRCULATION PUMP NUT

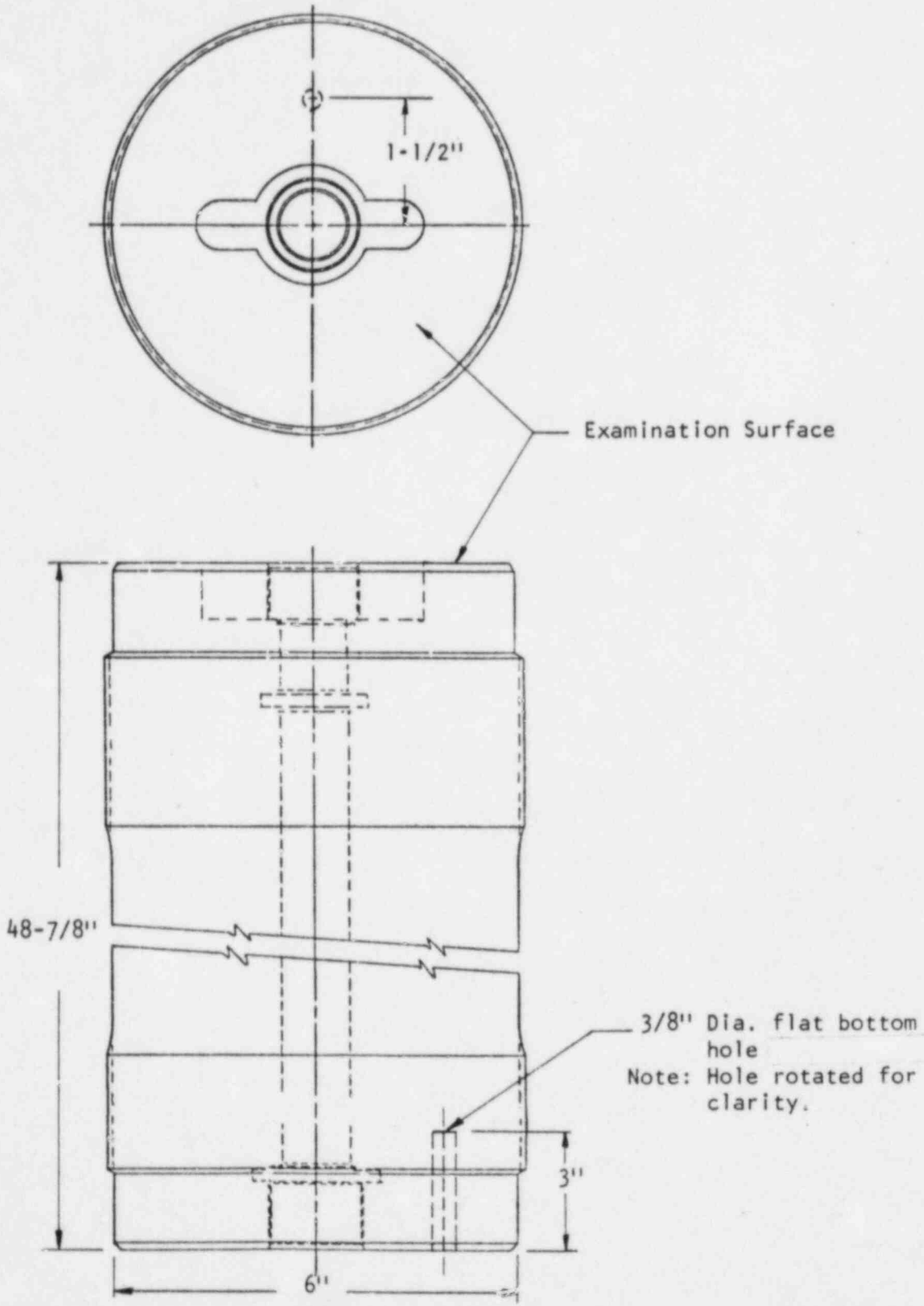


Figure 5. Ultrasonic Reference Standard STUD-6 for Closure Head Studs

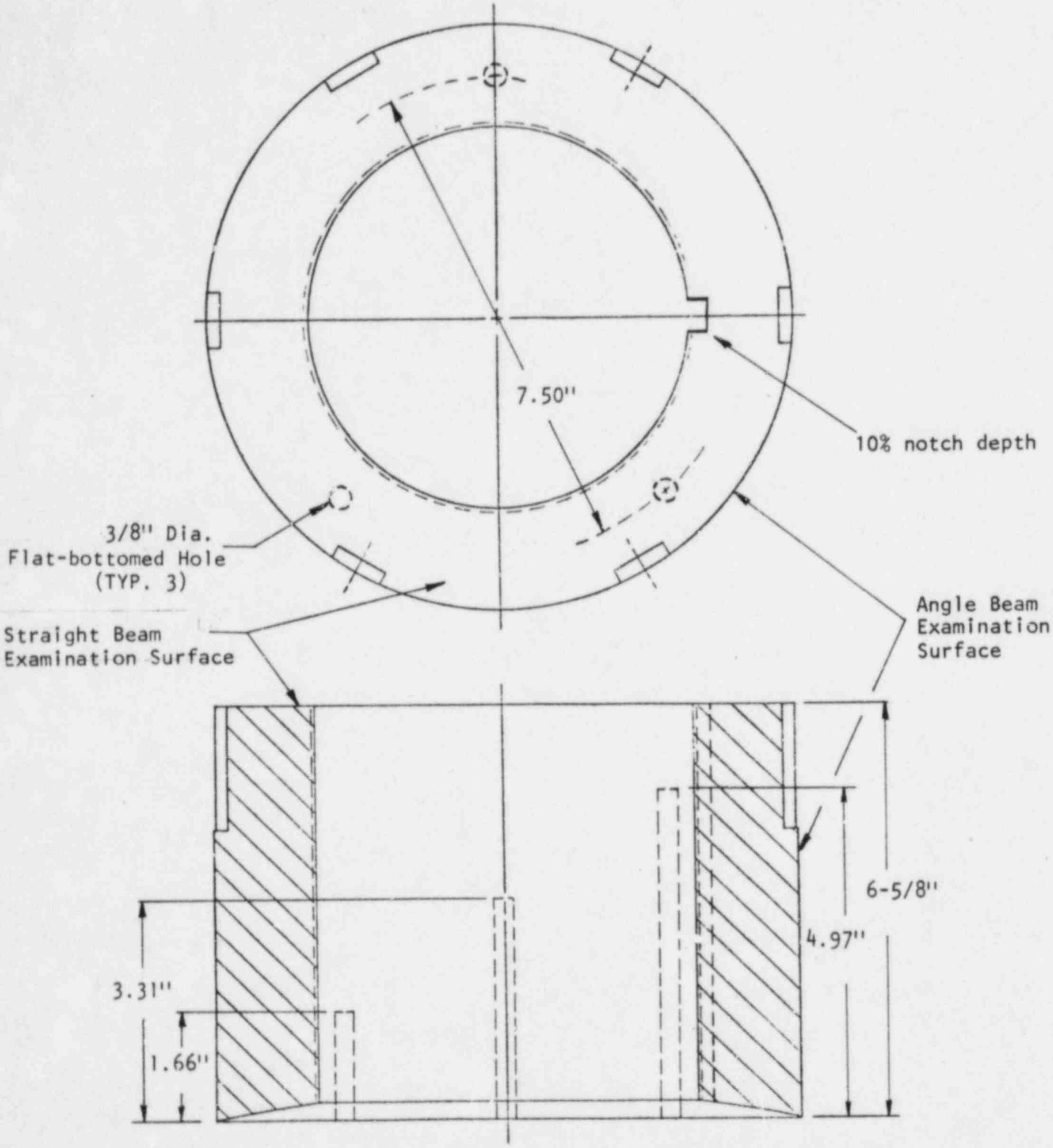


Figure 6 Ultrasonic Reference Standard NUT-6 for Closure Head Nuts

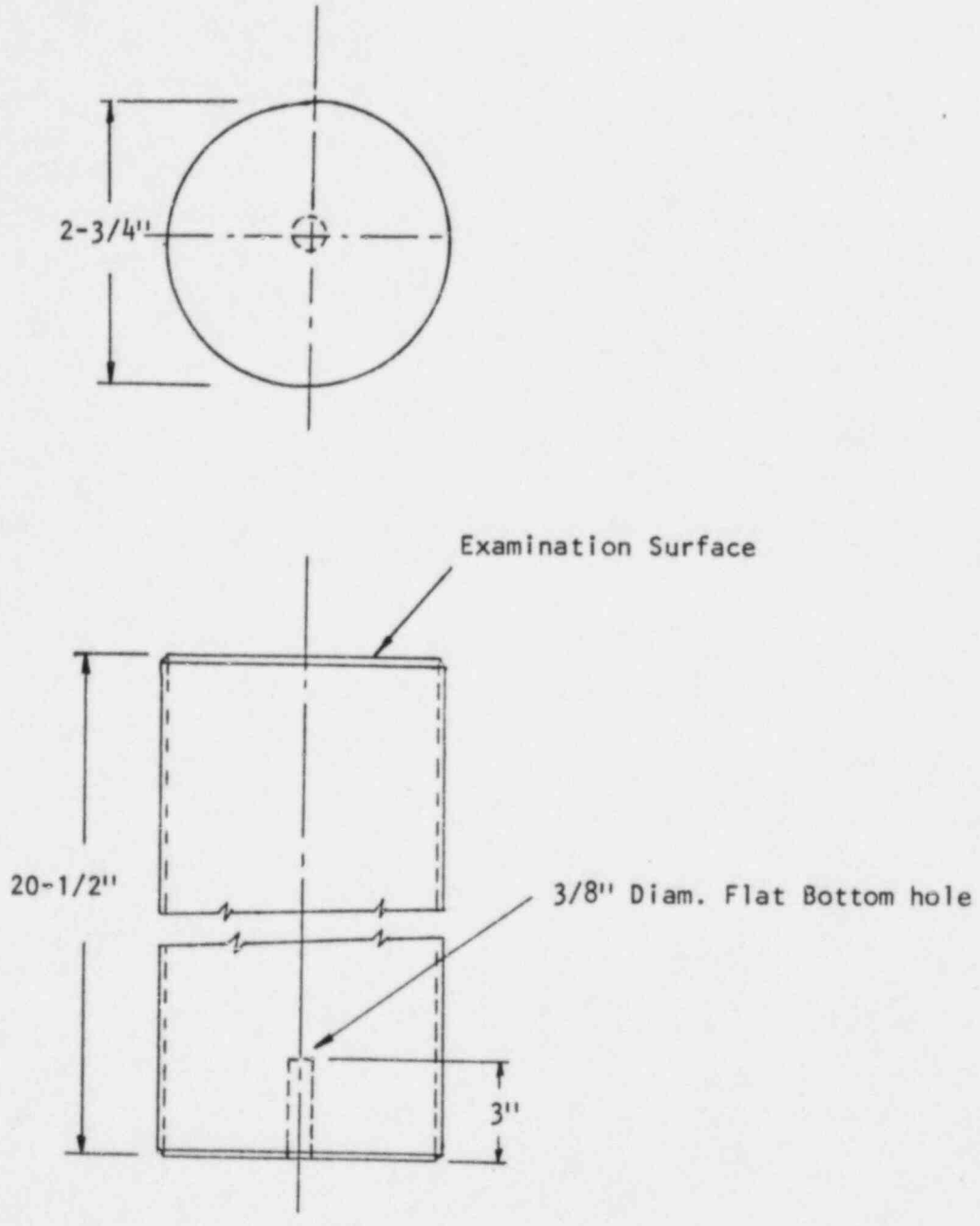


FIGURE 7 ULTRASONIC REFERENCE STANDARD STUD-3 FOR RECIRCULATION PUMP STUD

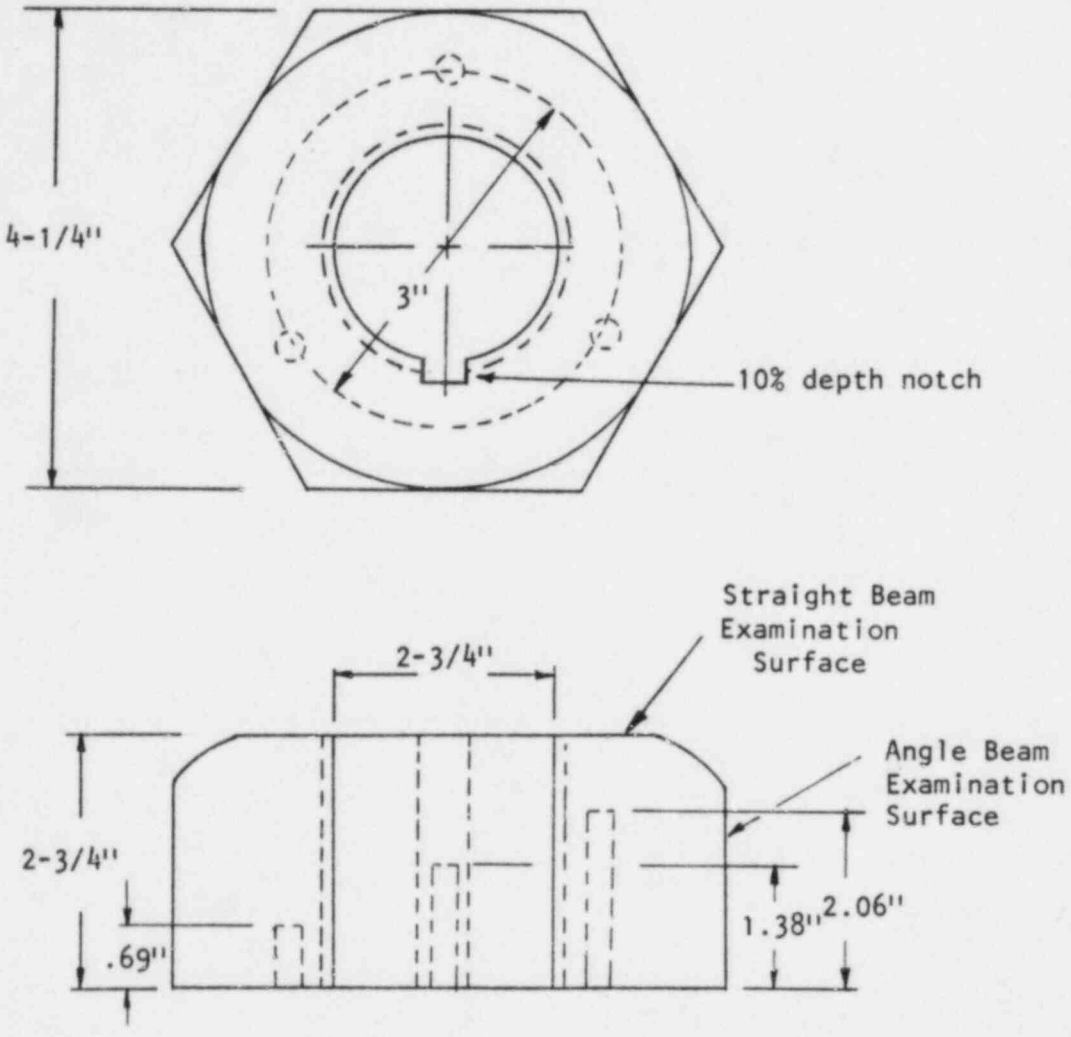
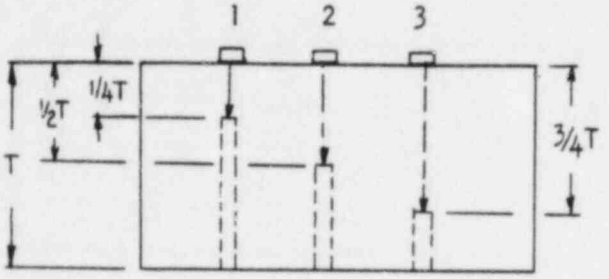
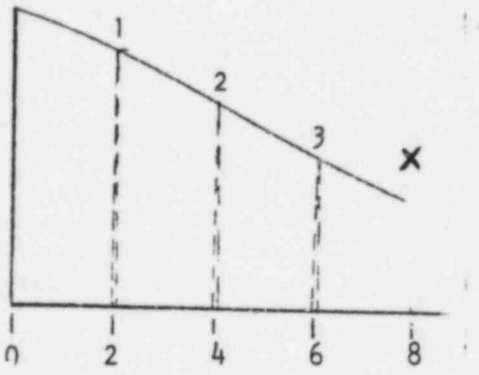


FIGURE 8 ULTRASONIC REFERENCE STANDARD NUT-3 FOR RECIRCULATION PUMP NUT





Typical DAC Curve

Step 1 - Adjust sweep controls so that 1/4T, 1/2T, and 3/4T holes are located respectively on the 2nd, 4th, and 6th horizontal screen positions.

Step 2 - Adjust sensitivity to provide 80% FSH indication from hole giving maximum response - mark position on screen.

Step 3 - Position search unit for maximum response from remaining holes - mark position on screen.

Step 4 - Plot DAC by connecting points marked on screen with line extended to cover entire examination range.

Step 5 - For angle beam calibration only, adjust sweep controls so that the notch is located on the 8th horizontal screen position and adjust sensitivity to provide 80% FSH indication. Mark screen with an "X".

Step 6 - Record all sweep and sensitivity control settings on respective data sheets.

Figure 9 - Reference Sensitivity and DAC Calibration Procedures for Ultrasonic Examination.

Plant/Unit_____
Comp/System_____

CALIBRATION DATA SHEET

Data Sheet No._____
Procedure No._____
Subject_____
Rev/Change No._____
Calibration
Block No._____
Surface_____
Block Temp_____°F
Comp. Temp_____°F

INSTRUMENT SETTINGS
Mfg/Model No.:
Serial No. :
Sweep Length :
Sweep Delay :
Pulse Length/Damping:
Freq.: Rep. Rate:
Filter: Video: Jack:
DEC/Gate Switch: Range:
Mode Select: Reject:
Gain (coarse): (fine):

SEARCH UNIT
Scan Angle: Mode:
Fixturing (if any):
Style or Type No. :
Size & Shape :
Frequency :
Serial No/Brand:
Measured Angle :
Cable Type & Length:

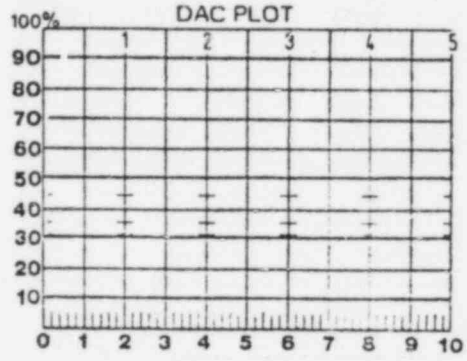
Couplant Brand:
Couplant Batch:

IDENT.	DEPTH in.	AMPL. %	ATTEN. dB

INSTR. LINEARITY CAL.					
Amplitude					
	High	Low		High	Low
1			5		
2			6		
3			7		
4			8		

SCAN AREA	
0° WRV	
0° Mat'l	
⊥to Weld	
=to Weld	

DAC PLOT



AMPL. CONTROL LINEARITY		
Initial	Δ dB	Result
80	-6	
80	-12	
40	+6	
20	+12	

EXAMINATION WELD/AREA	RECORDABLE INDICATION		COMMENTS/REASON FOR INCOMPLETED SCAN(S)
	Yes	No	

CALIBRATION CHECKS	TIME
Initial Cal.	
Intermediate	
Intermediate	
Intermediate	
Final Cal.	

ADDITIONAL SHEETS? (CHECK BOX)			
Continuation		Beam Plot	
Supplements		None	

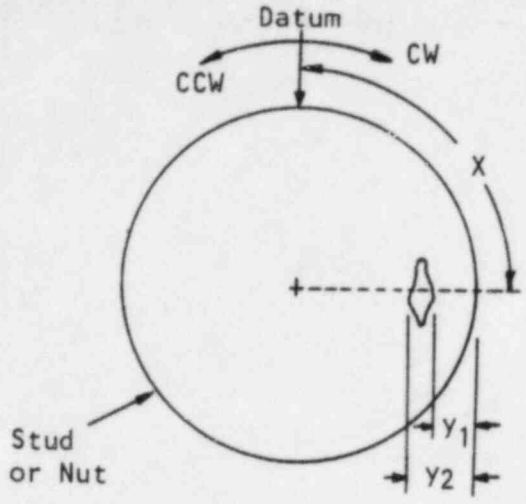
EXAMINERS 1 _____ Date_____ Level_____

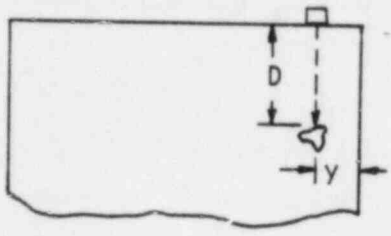
2 _____ Date_____ Level_____

REVIEWER _____

NUCLEAR ENERGY SERVICES, INC.

Figure 10 Calibration Data Sheet





SUPPLEMENT A

STUD AND NUT
INDICATION REPORT SHEET

Procedure No. _____
Subject _____
Area No. _____
Page _____ of _____
Attached to Cal.
Data Sheet No. _____

Notes:

(1) X-axis increments not to exceed allowable scan increments.
(2) End points shall be: 50% of DAC (6db)

INDICATION NO.	SIDE OF DATUM	D (in T/8s)	X (1)	MAX % DAC (±db)	Y @ MAX % DAC	FORWARD (f) ENDPOINT Y_1 (2)	BACK (b) ENDPOINT Y_2 (2)

COMMENTS

EXAMINERS

1. _____ Date _____ Level ____

2. _____ Date _____ Level ____

Reviewer _____ Date _____

TABLE I

WELD IDENTIFICATION

NUCLEAR COMPONENTS

DESCRIPTION	REFERENCE BLOCK	REFERENCE FIGURES	NOTES
Closure Head Studs - 325-01-01 thru 52	STUD-6	Figures 1, 5	Scan One End Only
Closure Head Nuts - 325-02-01 thru 52	NUT-6	Figures 2, 6	
Recirculation Pump (B31-001A) Studs 1 thru 16	STUD-3	Figures 3, 7	
Recirculation Pump (B31-001A) Nuts 1 thru 16	NUT-3	Figures 4, 8	
Recirculation Pump (B31-001B) Studs 1 thru 16	STUD-3	Figures 3, 7	
Recirculation Pump (B31-001B) Nuts 1 thru 16	NUT-3	Figures 4, 8	